

# **PENTAX<sup>®</sup>**

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## **AUTOMATIC LEVEL**

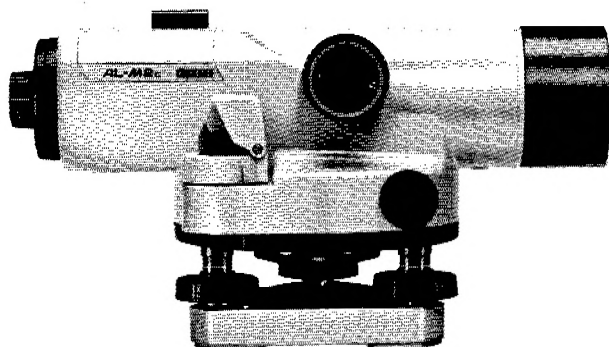
# **AL-M2 SERIES**

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**AL-M2 · AL-M2c · AL-M2s**

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## **INSTRUCTION MANUAL**



**ASAHI PRECISION CO., LTD.**

## **(For proper operation of instrument)**

Pentax automatic level AL-M2 series consist of a variety of instruments in order to comply with a wide range of surveying from second or third order leveling surveying to civil engineering requiring high accuracy.

Our surveying instruments are precise in function and precision made. Surveying instruments do not either work well nor become of value unless they are carefully handled and operated. For the instrument to work efficiently and be useful for long time, read through this instruction book.

### **Storage**

This instrument should be stored in a dry, dust-proof room, which does not have a big temperature range. When the instrument is stored for a long time, it must occasionally be taken out of the case and air circulated freely around the instrument. When storage or transportation temperature is extremely different from the working temperature, the instrument must be allowed to come to the ambient temperature. Exposure time required is approximately one minute per one degree temperature difference.

### **Transport**

For shipment, the instrument should be packed with cushioning material with reasonable thickness on all sides. Insurance coverage is recommended. Vehicle transportation does not require packing but movement should be restricted by securing it. When heavy vibration or rough travel is encountered, it is recommended that the instrument be secured in a padded box.

### **Checking**

Before measurement, an instrument should be examined according to this instruction book. If necessary, the instrument should be adjusted. Even a new instrument or completely repaired instrument needs to be checked. This procedure is also recommended during long intervals of non-use or after long journey. At least once per year, or more often, it is recommended that the instrument should be checked by a qualified Pentax dealer.

**Unpacking**

When removing an instrument from its carrying case, pay attention to how it is positioned so that it can be returned properly. Grasp the instrument securely when removing or returning it from or to the case.

**Setting up**

When installing or removing the instrument on or from the tripod, the instrument should be securely held with one hand while the other hand manipulates tripod center screw. The instrument should never be left on the tripod without being fastened down. Failure to carry out these instructions can result in a bad accident. Careful operation and handling of the instrument in accordance with these instructions and plain common sense will provide long and useful service.

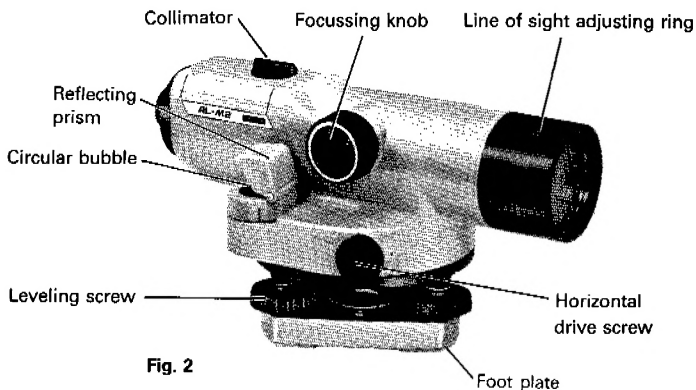
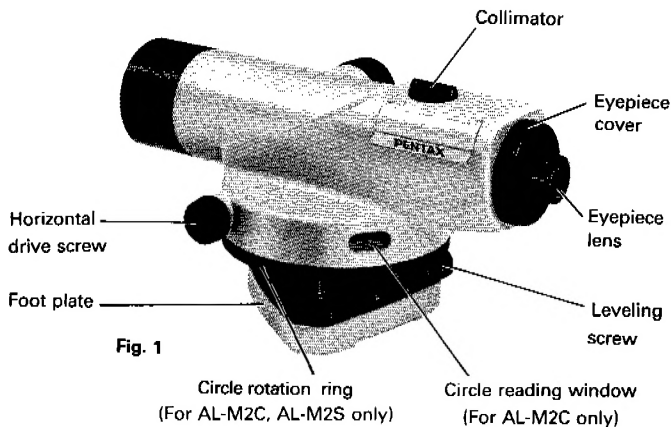
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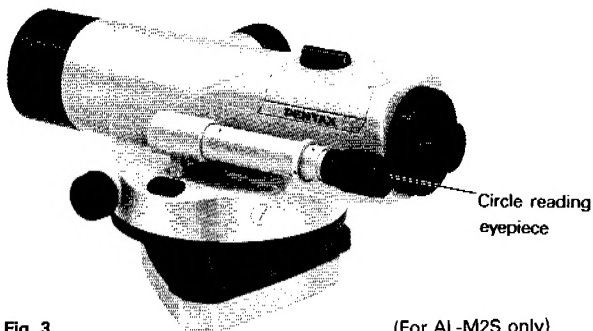
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## **1. Features**

- Easy to operate due to simple design, and compact and light construction.
- The telescope is of dust – and water resistance, enabling use of the instrument in the rain or tunnel with humidity.
- Minimum focus distance is extremely short, 0.8m. Anallactic optics of the telescope makes stadia surveying easy as the stadia constant is 0.
- With special alloy ribbon with long-established reputation, a newly developed automatic compensator having magnet damper is of wire-suspension type and provides extremely stable surveying results even under unfavorable conditions such as vibration.
- Optical collimator provides fast and accurate sighting.
- Concurved foot plate fits domed head tripod as well as flat-head tripod.
- Adjustable reflecting prism permits operator to observe the circular level without changing his operating position, thus enabling easy confirmation of leveling.
- Clampless horizontal drive screw equipped with knobs on both ends provides endless movement of the telescope.
- AL-M2C with a horizontal circle permits horizontal angle measurement as well as angle setting.
- AL-M2S equipped with a glass circle graduated down to 10' or 10c permits angle measurement with higher accuracy. Fine-coarse focussing screw provides fast and accurate focussing.
- Electric illumination, parallel plate micrometer and diagonal eyepiece are available as optional accessories.

## 2. Description





**Fig. 3**

(For AL-M2S only)

### **3. Equipment**

#### **[1] Standard Equipment**

Instrument .....	1
Carrying case .....	1
Objective cap .....	1
Sunshade .....	1
Plumb bob (AL-M2C, M2S only) .....	1
Screw driver .....	1
Adjusting pins .....	2
Brush .....	1
Rain cover .....	1
Silicone cloth .....	1

#### **[2] Optional accessories**

Tripod (TS-3)	Parallel plate micrometer (SM3)
Electric illumination (EP)	Diagonal eyepiece (SBL1)

## 4. Specifications

	AL-M2	AL-M2C	AL-M2S
■ Telescope	(Internal Anallactic Optics)		
Image	Erecting		
Magnification	32×		
Objective aperture	45mm		
Resolving power	2.5"		
Field of View	2.3% (2.3m at 100m or 2.3 feet at 100 feet) or 1°20'		
Minimum focus distance	0.8m		
Stadia ratio	1 : 100		
Stadia constant	0		
■ Automatic Compensator			
Range	±12'		
Setting accuracy	±0.3"		
Standard deviation 1 km double run levelling	±1.0mm		
■ Circular level			
Sensitivity	8'/2mm		
■ Horizontal Circle	—	metal	glass
Diameter	—	100mm	88mm
Graduation	—	1° or 1G	10' or 10C
Reading method	—	Index	Index
Least Reading	—	1° or 1G	10' or 10c
Estimation Reading	—	0.1° or 0.1G	1' or 1c
■ Tripod attaching screw			
Thread	5/8" × 11		
■ Dimensions & Weight			
Length	254mm		
Width	140mm		
Height	137mm		
Weight	2.1 Kgs/4.6 lbs		2.3 Kgs/5.0 lbs
■ Case	350 (L) × 210 (W) × 200 (H) mm, 2.5 Kgs/5.5 lbs		
Tripod TS-3	1~1.7m Length, 4.5 Kgs/9.9 lbs		



## 5. Operation

### 1 Preparation for surveying

#### 1) Setting up the tripod

- ① Prepare the tripod having a center locking screw with  $5/8" \times 11$  thread.
- ② Dig the legs firmly into the ground and adjust the tripod to the height suitable for observation when the instrument is mounted.
- ③ For angle measurement, set the tripod so that the center of the tripod head is positioned right above the ground point.

#### 2) Setting up the instrument

- ① Mount the instrument on the tripod head and secure it using a center lock screw. (Fig. 4)
- ② Suspend the plumb bob from the hook, adjusting the length of the string. (for angle measurement)
- ③ Loosening the center lock screw, move the instrument with the tips of fingers. Tighten it as a tip of plumb bob coincides with the ground point. (for angle measurement)

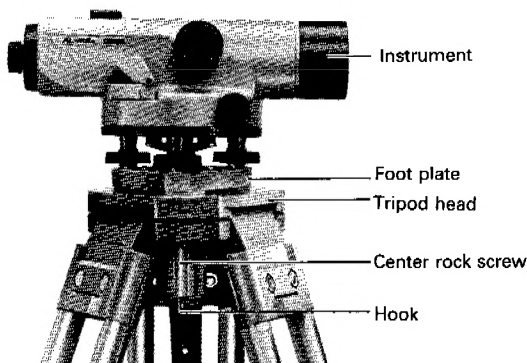
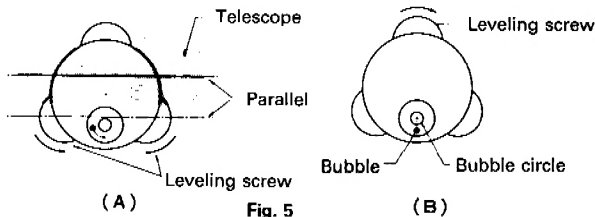


Fig. 4

### 3) Leveling

- ① Place the telescope in parallel to the line connecting two optionally selected leveling screws, and turn them to move the bubble of the circular level at a position even to the left and the right. (Fig. A)
- Turn the two leveling screws in opposite directions.
- ② Turning a remaining leveling screw, shift the bubble to the center. (Fig. B)
- ③ Make sure that the bubble stays at the center of the circle even after turning the telescope  $180^\circ$ .
- See arrows in Fig. A and B for the relation between the direction of leveling screw rotation and the bubble shifting direction.
- If the bubble is out of the center in ③, "adjustment of the circular level" on page 15 is needed.



### 2) Observation

#### 1) Reticle collimation

- ① Remove the objective cap. If necessary, attach the sunshade.
- ② Directing the telescope to the bright background, rotate the eyepiece counterclockwise to draw out the eyepiece ring.
- ③ While looking into the eyepiece, rotate it clockwise until the cross hair of the reticle comes to its extreme sharpness.
- It is advisable to relax when looking into the eyepiece. An intense look at the reticle may tend to cause parallax or eye fatigue.

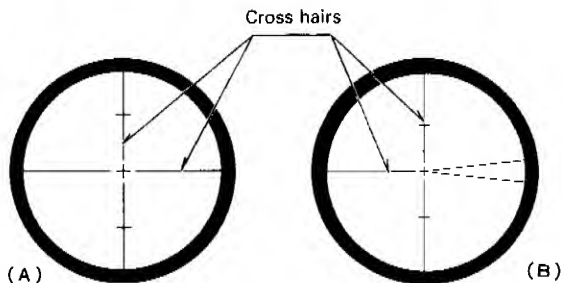


Fig. 6 Field of view

## 2) Sighting

- ① Sight the telescope at the object looking through the collimator.
- ② Looking into the eyepiece, rotate the focussing knob until the object becomes clearly visible. Make sure that the relation between the object and the cross hair does not change even when you move your eye up or downward. (Fig. 7)

■ If parallax exists in ②, the relation between the object and the cross hair may change. This may cause surveying error.

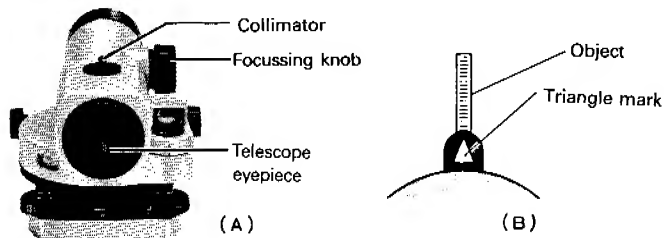


Fig. 7

### 3) Reading the staff

How to read the graduation on the staff.

Reading value 2.195m

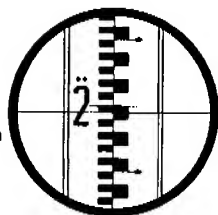


Fig. 8

- Reading of the staff should be done at the center of the cross hair on the reticle.

### 3) Surveying

#### 1) Leveling

- How to get the difference in height and the elevation  
Difference in height ( $\Delta h$ ) = backsight (b) – foresight (f)

**Elevation at point B ( $h_b$ )** = Elevation at point A ( $h_a$ ) +  $\Delta h$

S (I): Staff (I)

S (II): Staff (II)

I: Instrument

B.S: Backsight (Staff reading at the point where elevation is specified.)

F.S: Foresight (Staff reading at the point where elevation is unspecified.)

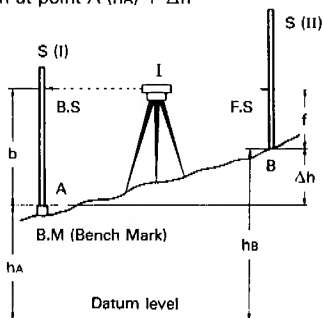


Fig. 9

$$\begin{aligned}\text{Difference in height } (\Delta H) &= \Sigma \Delta h \\ &= \Sigma b - \Sigma f\end{aligned}$$

$$\text{Elevation } H_B = H_A + \Delta H$$

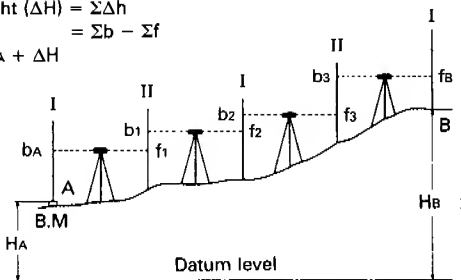


Fig. 10

- Set the instrument at almost middle of two staffs.
- When reading the staff, try to get least reading by tilting the staff back and forth slightly.
- For more precise surveying, use the double run method.

## 2) Stadia survey

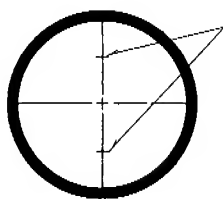
Distance from the instrument to the staff can be measured by the stadia hairs visible within the field of view of the telescope.

- To measure the distance is easy as stadia constant is 0.

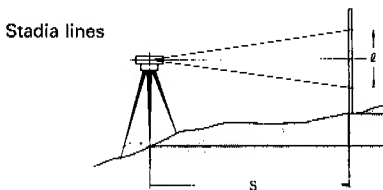
S: Horizontal distance

$\ell$ : Difference in reading between of upper and of lower stadia lines

$$S = 100 \ell$$



(A)



(B)

Fig. 11

### 3) Angle measurement (except for AL-M2)

Models equipped with a horizontal circle are capable of horizontal angle measurement or setting.

#### ■ Example

#### ① For AL-M2C

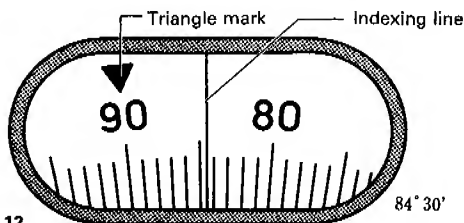
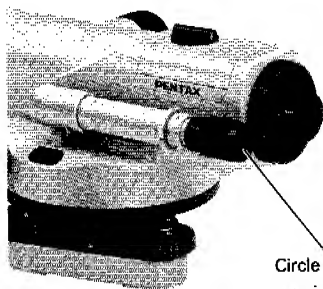


Fig. 12

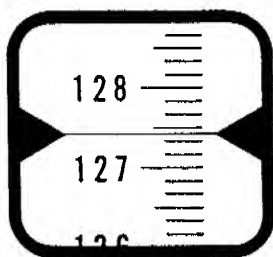
■ When reading horizontal angle, be sure and put yourself just in front of it.

■ Make use of symbol ▼ marked every 90° or 100G for right angle setting.

#### ② For AL-M2S



(A)



127° 25'  
(B)

Fig. 13

## 6. Maintenance and packing

### 1 Maintenance

- ① Clean dust or water from the instrument and then put it back to the case after using it.
- ② Brush dust off, wipe off moisture on exposed parts with a soft cloth.
- ③ Wipe off the moisture on the surface of the lenses with a cotton cloth, using light pressure, after brushing the dust off.

### 2 Packing

- ① Gently put the instrument into the case, facing focussing knob toward you.
- ② Close the case and secure the latch.

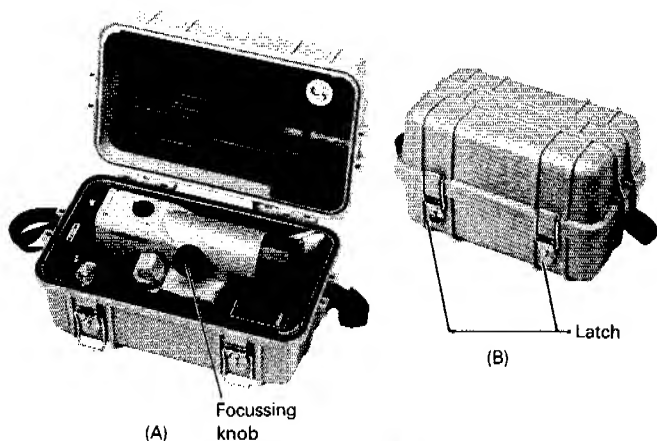


Fig. 14

## **7. Precaution**

- ◇ Attach the sunshade to the telescope to avoid the direct sunlight when high precise survey needed.
- ◇ Operate the instrument carefully. Do not apply excessive pressure to it.
- ◇ Store the instrument in a dry place, removing dust or moisture after use of it.
- ◇ Be careful not to subject the instrument to impact or vibration during transport.
- ◇ When moisture or disorder is found inside the lens, contact your dealer, do not attempt to dismantle the instrument by yourself.
- ◇ When any malfunction due to falling down or some other cause is recognized, contact your dealer, do not attempt to forcibly dismantle the instrument by yourself.
- ◇ Check all parts of the tripod are firmly secured.

## **8. Inspection and adjustment**

### **1 Circular level**

#### **1) Inspection**

- ① Setting the instrument on the tripod, level it so that the bubble of circular level is positioned at the center of the circle. (Refer to P.9 "Leveling".)
- ② Turn the telescope 180°.
- ③ No further adjustment is necessary if the bubble stays at the center of the circle.

#### **2) Adjustment**

- ① if the bubble moves out of the center in the circle, turn the leveling screw to shift the bubble halfway back after taking off the reflecting prism. (Fig. A)
- ② Shift the bubble remaining halfway to the center by turning adjustment screws. (Fig. B)
- ③ Turn the telescope 180° to check to see if the bubble stays at the center of the circle.
- ④ Repeat again from ① should the bubble move.



- When doing adjustment, finish screws being firmly tightened.

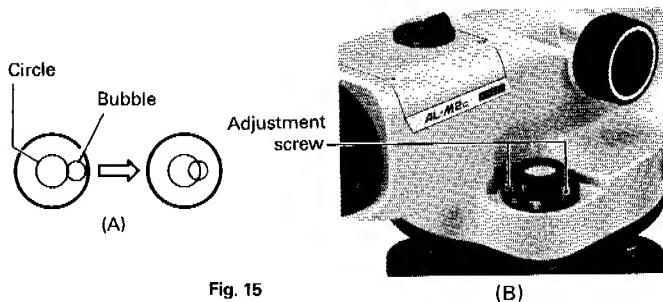


Fig. 15

## 2 Leveling line of sight

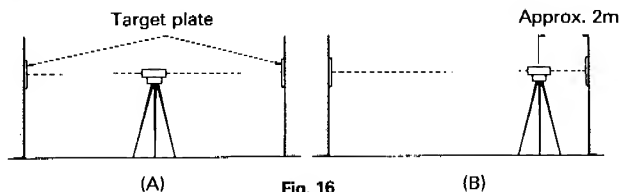


Fig. 16

### 1) Inspection

- ① Prepare two same target plates. Setting up the instrument midway between two walls at a distance of 50 to 100 meters, level it. (Fig. 16(A))
- ② Sighting both walls alternately, adjust the target plates to the height so that readings of the target plates are identical, and secure them in position.
- ③ Move the instrument to a position approx. 2 meters from one target plate and level it. (Fig. 16(B))
- ④ Read both target plates.
- ⑤ No adjustment is necessary if readings of both target plates are identical.

## 2) Adjustment

- ① Sight the farthest target plate through the telescope.
- ② Remove the eyepiece cover, rotate the reticle adjusting screw using the adjusting pin and adjust the reading to be identical to that of the nearest target plate.
- ③ After checking that correct adjustment has been made, mount the eyepiece cover back in place.

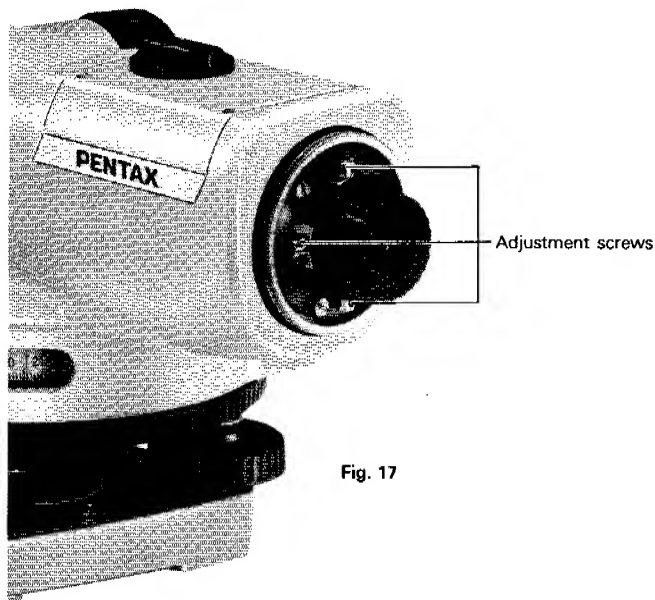


Fig. 17

## 9. Optional accessories

### 1 Electric illumination [EP]

Electric illumination permits surveying work in a tunnel or any dark place by way of illuminating the reticle.

Light source ..... Green LED

Power supply ..... Two 1.5V dry batteries (SUM-3)

- ① It can be mounted in the same way that a sunshade is attached to the telescope objective.
  - ② Turn the switch on and adjust brightness by rotating illuminator knob while looking into the telescope.
- Remove battery when device will not be used for an extended period as extended storage may cause damage to the device due to leakage of battery acid.

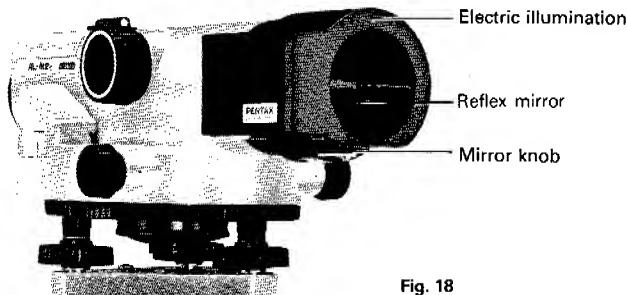


Fig. 18

## 2 Parallel plate micrometer [SM3]

Parallel plate micrometer is used for leveling or civil engineering work requiring precise accuracy. With a bright microscale etched on optical glass, it provides reading down to 0.1mm.

- Use the instrument with wedge type reticle for use of the parallel plate micrometer.
- Replacement of the reticle if your instrument is equipped with ordinary reticle should be made at your dealer.
- Use second order staff or equivalent to it, not ordinary one.

### Operation

- ① Mount the parallel plate micrometer horizontally on the object and counter-weight on the eyepiece of the telescope, respectively and secure both. (Fig. 19)
- ② Turning the micrometer knob, accurately put the staff graduation between the wedge-shaped lines. (Fig. 20)
- ③ Read the staff<sup>(A)</sup> and microscale<sup>(B)</sup>.

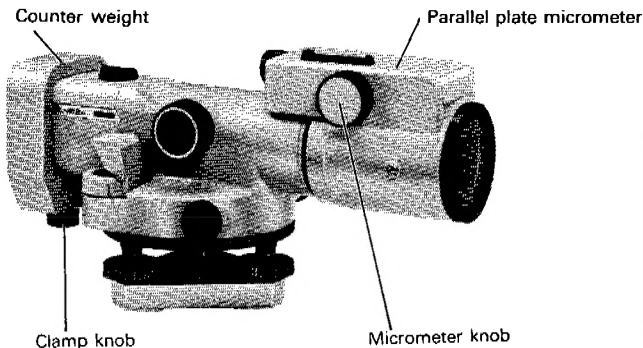
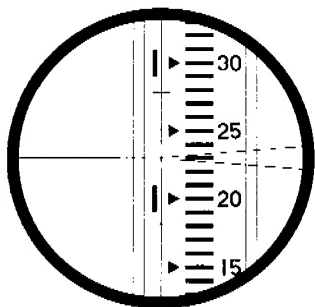
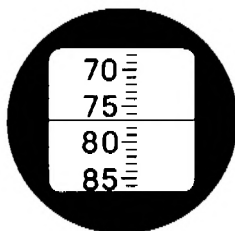


Fig. 19



(A) Staff



(B) Microscale

Fig. 20

Example:

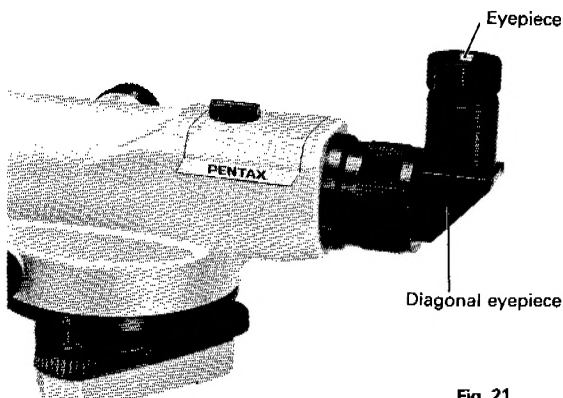
Staff reading .....	123.00cm
Micrometer reading .....	0.77cm
<hr/>	
	123.77cm

### **3 Diagonal eyepiece (SBL1)**

Diagonal eyepiece [SBL1] is to be used for surveying in a limited space or when the instrument is set at a lower position where it is hard to look into the telescope.

#### **Operation**

- ① Remove the eyepiece cover, turning it counterclockwise. (Fig. 1)
  - ② Screw the diagonal eyepiece in to the attaching screw of the eyepiece cover. (Fig. 1)
  - ③ Looking into the eyepiece lens of the diagonal eyepiece, collimate the reticle. (Fig. 21)
- Prior to attaching the diagonal eyepiece to the instrument, collimate the reticle with eyepiece mounted on the telescope.



**Fig. 21**

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